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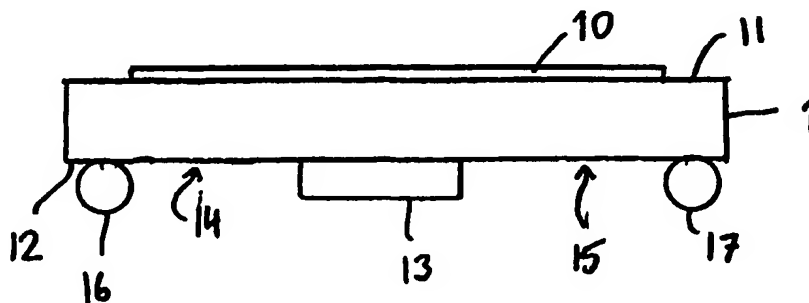
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(54) Title: **MODULE FOR RADIO COMMUNICATION**



(57) Abstract: A module for radio communication in accordance with the Blue Tooth concept and/or in accordance with the wireless-LAN concept, wherein the module comprises a transmitter-and-receiver circuit and an antenna. The invention is characterised in that the module comprises a carrier in the form of a laminated PCB-card (1) (Printed Circuit Board) that includes a number of electrically conductive metal layers (M1-M5) and so-called microvias; in that a first side (11) of the card (1) has an integrated antenna (10) formed in the metal layer (M5) on said side and connected to the remainder of the module; in that a radio frequency chip (13) is surface-mounted on the PCB-card (1) on other side (12) of said card; in that passive components (14, 15), such as filters, Baluns, inductors and capacitors, are integrated in the PCB-card (1) and connected to different microvias; and in that terminals in the form of BGA balls (16, 17) (Ball Grid Array) are provided on said second side (12) of the card.

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## MODULE FOR RADIO COMMUNICATION

The present invention relates to a radio communications module and more specifically to a module for communication in accordance with the Blue Tooth concept and the Wireless LAN (WLAN) concept.

The main purpose of the Blue Tooth concept is to replace cables with radio signals when the range required is relatively short. The main purpose of WLAN is to obtain wireless access to the Internet.

Both techniques use the ISM (Industrial, Scientific and Medical) frequency band. Blue Tooth will operate at 2.4 GHz, whereas WLAN will operate at both 2.4 and 5.7 GHz.

In coming years, hundreds of millions of modules for these techniques will be required when the techniques are introduced onto the market.

Consequently, it is a desire that modules for these techniques will be small and can be produced in large numbers at low cost.

The present invention satisfies these desiderata.

Accordingly, the present invention relates to a module for radio communication in accordance with the Blue Tooth concept and/or in accordance with the wireless LAN concept, said module comprising a transmitter and receiver circuit and an antenna, wherein the module is characterised in that it comprises a carrier in the form of a laminated PCB – card (Printed Circuit Board) that includes a plurality of electrically conductive metal layers and so called microvias; in that a first side of the board carries an integrated antenna formed in the metal layer on said side and connected to the remainder of the module; in that the other side, of the card carries a surface-mounted radio frequency chip; in that passive components, such as filters, Baluns, inductors and capacitors, are integrated in the PCB-card and connected to different microvias; and in that terminals in the form of BGA balls (Ball Grid Array) are disposed on said other side of the card.

The invention will now be described in more detail partly with reference to an exemplifying embodiment of the invention illustrated in the accompanying drawing, in which

- Figure 1 is a side view of an inventive module;
- Figure 2 is a sectioned view through a PCB-card that includes so called microvias and a through-penetrating via;
- Figure 3 shows an integrated capacitor from above; and
- Figure 4 shows an integrated coil from above.

According to known technology, passive radio frequency components are mounted on a typical PCB-card (Printed Circuit Board) as discrete components together with semiconductor chips. More advanced technology uses thin films and ceramic multilayers to integrate certain passive components, such as filters and inductances. However, such technologies result in higher production costs than conventional PCB technology.

The present invention relates to a module that is fully integrated for Blue Tooth or WLAN.

Accordingly, the invention relates to a module for radio communication in accordance with the Blue Tooth concept and/or in accordance with the wireless LAN concept, comprising a transmitter and receiver circuit and an antenna.

In accordance with the invention, the module includes a carrier in the form of a laminated PCB-card (Printed Circuit Board) 1 that has a number of electrically conductive layers interconnected with so-called microvias. Figure 2 illustrates microvias 2, 3, 4. The reference signs M1, M2, M3, M4 and M5 identify metal layers that are separated by dielectric material 6, 7, 8 and 9. The dielectric layer 6 suitably has a thickness of 0.8 to 1.5 mm, whereas the layers 7, 8 and 9 have a thickness of 0.05 mm.

The microvias function to connect the various metal layers together and also to connect components to the board 1.

M5 in Figure 2 is used to pattern and form the antenna 10. The layers M1-M4 are used as transmission conductors and integrated passive components, such as filters, Baluns, inductances and capacitances.

According to the invention, the antenna 10 is provided on a first side 11 of the card 1 and is connected to the layer M1 through a through-penetrating via 18. The thickness of the antenna in Figure 1 has been exaggerated. The antenna is conveniently a so-called patch antenna of a quarter wavelength. However, other types of antenna may be used, such as a so-called microstrip antenna or a loop antenna.

A radio frequency chip 13 is surface-mounted on the other side 12 of the card. Passive components 14, 15, such as filters, Baluns, inductors and capacitors are integrated in the Printed Circuit Board.

According to the invention, said other side 12 of the card carries terminals in the form of BGA balls 16, 17 (Ball Grid Array).

There is therewith formed a fully integrated communications module, which is connected to a circuit card through the medium of the BGA balls,

It will be understood that the number of metal layers may be greater or smaller than the number described above.

According to one preferred embodiment, one or more passive components of the aforesaid kind are integrated in the card 1 and formed by means of said metal layers M1-M4. Figure 2 shows in the central part 18 of the figure a capacitor formed by means of the metal layers. Figure 3 shows the capacitor from above as formed in the metal layers M1-M4.

The arrows in Figure 1 show the capacitor 14 and the coil 15 situated within the PCB-card.

Figure 4 shows from above a coil formed in the metal layer M1 or M2 in the right-hand part 19 of Figure 2.

The present invention provides a number of significant advantages over known technology. One significant advantage is that the module can be made very small. With a quarter-wavelength antenna, the external measurements of the module may be 16x18x2.5 millimetres. There is also obtained a high radio quality owing to the absence of parasitic capacitances and inductances in electrical connections. Another advantage resides in the high sensitivity of the module, owing to the fact that requisite filters and Baluns are integrated in the structure. The cost of manufacture is also low.

Although the invention has been described above with reference to a number of exemplifying embodiments, it will be understood that the structural details of the module can be modified in accordance with the construction desired and desired performance.

Consequently, the present invention shall not be considered to be limited to the aforescribed exemplifying embodiments thereof, since variations can be made within the scope of the accompanying Claims.

**CLAIMS**

1. A module for radio communication in accordance with the Blue Tooth concept and/or in accordance with the wireless-LAN concept, wherein the module comprises a transmitter-and-receiver circuit and an antenna, characterised in that the module comprises a carrier in the form of a laminated PCB-card (1) (Printed Circuit Board) that includes a number of electrically conductive metal layers (M1-M5) and so-called microvias; in that a first side (11) of the card (1) has an integrated antenna (10) formed in the metal layer (M5) on said side and connected to the remainder of the module; in that a radio frequency chip (13) is surface-mounted on the PCB-card (1) on the other side (12) of said card, and in that passive components (14, 15), such as filters, Baluns, inductors and capacitors, are integrated in the PCB-card (1) and connected to different microvias; and in that terminals in the form of BGA balls (16, 17) (Ball Grid Array) are provided on said second side (12) of the card.
2. A module according to Claim 1, characterised in that passive components of the aforesaid kind are integrated in the card (1) and formed by means of said metal layers (M1-M4).
3. A module according to Claim 1 or Claim 2, characterised in that said antenna (10) is connected to the metal layer (M1) located on said second side (12), by means of a through-passing via (18).

Fig 1

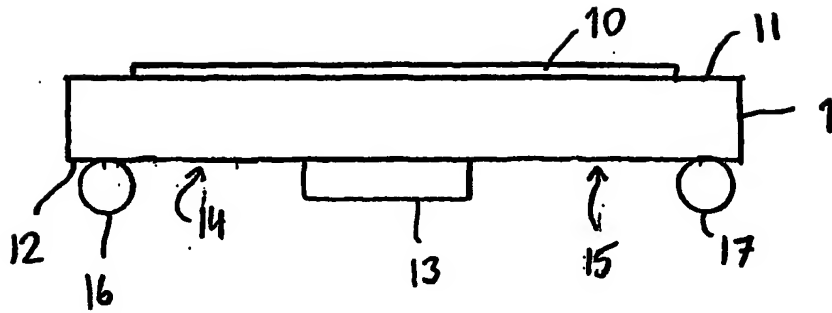


Fig 2

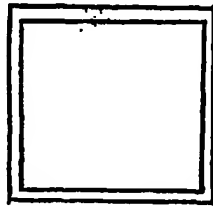
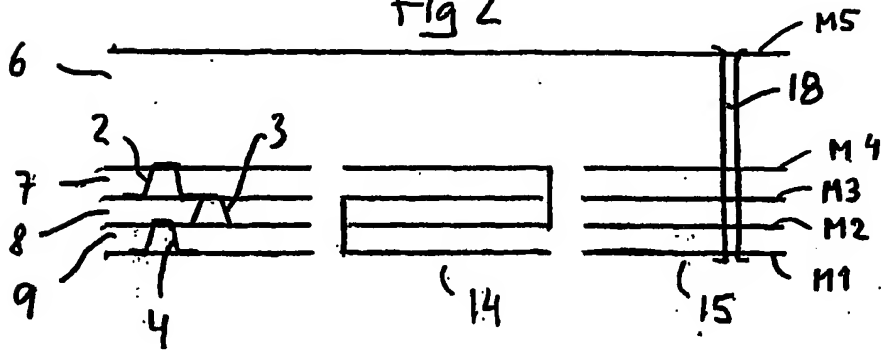


Fig 3

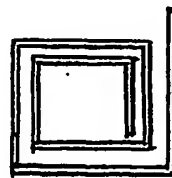


Fig 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/00949

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H05K 1/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H05K, H01L, H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI-DATA, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 6021050 A (MICHAEL F. EHMAN ET AL), 1 February 2000 (01.02.00), column 1, line 50 - column 2, line 25; column 2, line 60 - column 5, line 42 --	1,2
Y	GB 2321787 A (NOKIA MOBILE PHONES LIMITED), 5 August 1998 (05.08.98), page 1, line 1 - line 16; page 3, line 5 - line 10 --	1,3

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0962968 A2 (MURATA MANUFACTURING CO., LTD.), 8 December 1999 (08.12.99), column 4, line 12 - column 14, line 44  -- -----	1-3

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Information on patent family members

02/07/01

International application No.

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